Session Number: 4A
Session Title: Size Distribution of Wealth
Paper Number: 2
Session Organizers: Smeeding and Wolff
Discussant: Ruggles and Klevmarken

Paper Prepared for the 27th General Conference of
The International Association for Research in Income and Wealth
Stockholm, Sweden. August 18 – 24, 2002

Demographic Shifts in the Distribution of Wealth, 1992 to 1998: Evidence from the Survey of Consumer Finances

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The views presented in this paper reflect the judgments of the author alone and do not necessarily reflect the opinions of the Board of Governors of the Federal Reserve System. The author is grateful to Ryan Bledsoe and Amber Lytle for research assistance. Any errors in this paper are the responsibility of the author alone.

The 1990s saw a remarkable economic expansion in the U.S., and during that time, the structure of the economy shifted in often dramatic ways. For example, information technology became increasingly a part of everyday life for many people; innovations in regulation and financial markets led increasingly to the extension of sophisticated money management tools to the middle class. While technology affected the relative prices of many goods and services, it also indirectly affected the values of many assets. At the same time, the overall wealth also grew through the net accumulation of capital. That the wealth of the nation was greatly affected over this period is obvious, and it would be remarkable if the patterns of investment and capital gains and losses did not imply some change in the underlying distribution of wealth.

Following on work presented in Kennickell (2000a), this paper examines changes in the distribution of wealth from 1992 to 1998 using data from the Survey of Consumer Finances (SCF). The main focus of this paper is a graphical decomposition of the distribution. The empirical distribution of wealth and its changes are quite difficult to characterize fully in terms of the typical summary statistics (such as the Gini coefficient), though such statistics may have usefulness in answering specific questions. The devices presented here look as directly as possible at changes over entire distributions. In addition to examining the overall shifts in wealth, the paper looks at movements in the conditional distributions of wealth over age, income, educational, and regional groups.

The first section discusses the data briefly. The second section describes a means of displaying distributional changes in wealth between 1992 and 1998. The next section focuses on changes at the level of the four Census regions of the U.S. The fourth section looks at changes by demographic groups. A final section summarizes the findings and concludes.

I. Data

The data underlying the analysis reported here derive from the 1992, 1995, and 1998 waves of the SCF.[1] The survey is sponsored by the Board of Governors of the Federal Reserve

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[1]See Kennickell *et al.* (2000) for a general overview of the data, and Kennickell (2000b) for a more detailed introduction to the methodology of the survey. For other descriptive information, technical documentation, and data, see www.federalreserve.gov/pubs/oss/oss2/scfindex.html.

System in cooperation with the Statistics of Income (SOI) Division of the Internal Revenue Service. Data collection for these surveys was conducted by the National Opinion Research Center at the University of Chicago.

The survey is intended to provide cross-sectional information on wealth and other financial characteristics of U.S. households for use in a variety of research. To this end, the data collection effort in the SCF differs particularly in two ways from that of other U.S. surveys with wealth data. First, the survey questionnaire leads respondents through a carefully framed series of detailed questions covering all types of assets and liabilities. Because such an approach requires that respondents think explicitly about a variety of items, it is generally believed that they are less likely to forget elements of their portfolios. Moreover, various tools are built into the detailed structure to help respondents to estimate the value of items in cases where there is uncertainty (or to provide a general response where the true answer is seen by the respondent as sensitive) and to include relatively narrowly focused comments where there is confusion about the application of any questions to a given respondent's circumstances. Complications are inevitable, but such an organization enables more targeted and reliable editing after data collection than would otherwise be possible.

The second key difference is in the sample design. The SCF sample is selected from two independent sample frames. Many interesting financial questions require data from the whole economic range of households; the SCF obtains broad coverage of the population through the use of a multi-stage area-probability sample following traditional principles for the design of such samples. However, questions that turn on a good understanding of the representation of the total *value* of financial variables will not be as well supported by such a sample. Because wealth is highly concentrated, the best area-probability sample with no nonresponse would not provide a sufficient number of wealth observations for reliable analysis unless the sample were enormous. In addition, experience has indicated that relatively wealthy households are less likely to participate in surveys, and in the absence of a means of identifying such differences, wealth estimates from an area-probability sample would also be biased. The SCF methodology addresses both of these problems through the use of a list sample based on a sample of statistical records derived from individual tax returns by SOI. This set of records is used to estimate a proxy for the distribution of wealth among taxpayers, and this proxy measure is used to stratify

the file for sample selection. The list sample is selected with disproportionate representation for elements in strata with higher values of the proxy. Out of the two samples, approximately 4,400 households are interviewed, with about a third of those cases deriving from the list sample. Weights are used deal with nonresponse and to combine the area-probability and list samples for purposes of analysis; A system of replicate weights is used to estimate variability due to sampling.

After data collection, the survey answers and all comments by interviewers and respondents are carefully reviewed in an attempt to uncover erroneous values. Such editing makes a considerable difference in the ultimate estimates of the wealth distribution (see Kennickell (2002)). Missing data in the survey are imputed using multiple draws from estimates of the conditional distribution of the data. The variation across the multiple imputations makes visible a level of uncertainty that is disguised in surveys with only one imputation.

It is noteworthy that the SCF preforms quite well in matching independent estimates of the aggregate holdings of assets and liabilities from a U.S. flow of funds account (see Antoniewicz (2000)). In general, where conceptual differences can be resolved, the estimates are close. Where there are conceptual differences or where differences cannot be fully explored, the gap between the two aggregate estimates is sometimes larger. In contrast to Wolff's practice (see, for example, Wolff (1995)), no adjustments are made to the data to "align" the survey estimates with aggregate estimates or other external data, beyond the post-stratification adjustments embedded in the weights. As developed in detail in Kennickell (2000a), adjustments that force the survey estimates to external totals are often difficult to justify conceptually, and in practice may have perverse effects on estimates.

I. Overall changes in wealth

Empirical distributions are often quite complicated, and the varieties of distributional moments commonly used to describe univariate distributions can fall far short of being adequately descriptive. Comparisons between two distributions compound such problems. A graphical approach may provide more information. Quantile-quantile (Q-Q) plots are commonly used to compare distributions in their entirety (see Hoaglin *et al.* (1985)). In such figures, the values of one distribution at the various percentiles of its distribution are plotted against the

values at the same percentile points in the other distribution. However, when two distributions are even fairly similar, the points plotted cluster around a 45 degree line and most of the space in a rectangular graph is empty; as a result such compression, in such cases it is hard to see diffferences clearly. Moreover, many people find such plots unintuitive.

It is possible to avoid much of these drawbacks of Q-Q plots through a redisplay of the same data. By rotating a Q-Q plot through 45 degrees, the resulting plot may be interpreted as a "quantile-difference (QD) plot," that is, a graph of differences in the values of distributions at common percentile points.[2] The horizontal axis may be labeled either in terms of the common percentiles or in terms of the values of either of the distributions; this author has found the percentile labeling more straightforward to interpret.

Figure 1a is a Q-D plot of the distributions of families' net worth in 1992 and 1998.[3] The dots in the plot indicate the limits of the 95 percent confidence interval about the central estimate.[4] The vertical axis, which shows the values of the percentiles of the 1998 wealth distribution minus the corresponding values for the 1992 distribution, is scaled using the inverse hyperbolic sine (with a scale parameter of 0.0001); this transformation has the convenient property of being approximately logarithmic away from zero and approximately linear closer to zero. The horizontal axis shows the common percentiles of the two distributions.

As shown in the figure, the bottom of the distribution was more in debt in 1998 than in 1992, and for part of the bottom, the shift was statistically significant. At the very bottom, there are large negative values of net worth, often reflecting failed investments. In a region centered

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[2]Such plots were introduced in Kennickell (1997).

[3]The wealth measure used throughout this paper is a broad net worth concept. Assets are taken to include financial assets, pension accounts from which withdrawals can be made or against which loans may be taken, real estate, businesses, vehicles, and miscellaneous assets. Debts are taken to include all types of loans from financial institutions, other institutions, and individuals, as well as loans against pension accounts. The term "family" is used as a euphemism for the primary economic unit within each household interviewed. See Kennickell *et al.* (2000) for details.

[4]The confidence intervals are point-wise statistics computed using the SCF bootstrap replicates along with an experimental version of the associated replicate weights described in Kennickell (2000).

around the 10th percentile, there was essentially no change between the two years–that is, for this group, which holds approximately zero wealth, nothing changed. Above about the 15th percentile, there were progressively larger increases in the 1998 level over the 1992 level, and at the very top, there is a sizeable leap. As discussed in Kennickell (2000a), the growth at the top appears to have been driven in part by increases in the values of stocks and closely-held businesses, assets that are highly concentrated at the top of the wealth distribution.

These results suggest that there may have been a broad shift of wealth toward the upper end of the distribution. While this point is obviously the case in pure dollar terms, it does not necessarily follow that the shares of total wealth moved in the same way–such change would require differential proportional changes. To address this question, figure 1b shows the same changes in figure 1a as a percent of the 1992 wealth values.

Above about the 15th percentile, the data show that the proportional wealth gains were substantial and approximately equal up until the a point near the top of the distribution where there is a large spike in the rate of increase. Moreover, the confidence intervals indicate that this spike is statistically significantly different from the increases experienced by the 80 percent of the distribution below that region.[5] The net effect on concentration, was to raise the share the share of the top 1 percent of the distribution from 30.1 percent of total net worth in 1992 to 33.0 percent in 1998, while the share of the bottom 90 percent fell from 33.0 percent to 31.3 percent and that of the 90th to 99th percentiles also fell from 36.9 percent to 34.7 percent.

One point should be emphasized here. The data used here are cross-sectional. Thus, the comparisons are of distributions, not of individuals. Individuals may have moved from one region of the distribution to another as a result of changes in household composition, returns on assets, or saving (positive or negative). See Kennickell and Starr-McCluer (1997) for a review of SCF evidence for the wealth mobility of individual families.

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[5]The SCF sample explicitly excludes individuals who are members of the "*Forbes* 400." However, if that group were included, the spike would appear even sharper (see Kennickell (2000)).

II. Regional changes in wealth

Over the 1990s, various economic factors had differential effects on the regions of the country. For example, growth in the computer industry particularly affected the economies of California and Washington State. Growth in the financial sector had particularly great effects in the northeastern part of the U.S. Data from the SCF over this period allow one to look directly at the net effect of all changes over the four Census regions of the U.S. Figure 2 provides all six pair-wise Q-D plots of wealth in the four regions overlaid for 1992, 1995 and 1998–all in 1998 dollars.[6] Several interesting patterns appear.

Above about the 30th percentile, wealth in the northeastern region tends to be progressively higher than in the north central region (figure 2a) or the southern region (figure 2b) over the 1992-1998 period. However, there is little to suggest a consistent trend to any changes. Compared to wealth in the western region (figure 2c), wealth in the northeastern region appears to have grown more strongly in the middle of the distribution; the pattern at the top of the distribution, though somewhat unstable over time, suggests that the top quarter of the distribution in the western region is wealthier than the comparable group in the northeastern region.

Like the northeastern region, the north central region has higher wealth than the southern region (figure 2d) across most of the distribution; however, at the top of the distribution, there are noisy, but consistent, signs of a decline in the level of the north central distribution, with that distribution being distinctly below that for the southern region in 1998. In 1992, the distribution of wealth in the north central region above about the 40th percentile was notably below that for the western region (figure 2e). Since then, the data show a trend of relative increases for the north central region across the broad middle of the distribution. At the top, the time pattern is less clear, but it all years, the wealth levels in the western region at the common percentile points are substantially larger.

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[6]Because of choices in design of the SCF replicate weights used for variance estimation, these weights cannot be used to provide a useful indication of sampling variability for across the four regions (see Kennickell (2000b)). The 1995 results are included in the figures to give an additional indication of the stability of patterns and to reinforce any indications of trends over the period.

The comparison of the southern region with the western region (figure 2f) is similar to that of the north central and western regions. However, in this case the relative improvements in the southern region are somewhat smaller.

III. Changes in wealth over demographic groups

In terms of income, the 1990s saw changes in income inequality in the U.S. by many measures (see Bernstein *et al.* (2000), Rector and Hederman (1999), and Williams (1993)). Computer programmers, who at least in the popular image are young, were in great demand in many areas. For some workers and executives, stock options replaced immediate income as a compensation instrument, and for those who were clever or lucky enough to work for firms that experienced a successful IPO or a boom in stock prices, great wealth was produced. Many other such factors combined to make the time one of flux at the level of individual households. In light of such change, one would expect that the conditional distributions of wealth over such demographic characteristics as age, income, and education would also have shifted.

Although it is difficult to characterize succinctly changes in a univariate distribution, the problem is amplified when comparing conditional distributions, because at every value of the conditioning variable, one has a separate distribution of wealth. However, it turns out that the natural ordering of the conditioning variables considered here allow for a useful graphical summary of changes.

For 1998, figure 3 provides an estimate of the conditional distribution of wealth by the age of the "head" of the household.[7] The plot shows the contours of the estimated 90^{th}, 75^{th}, 50^{th}, 25^{th}, and 10^{th} percentiles of the conditional distribution of wealth given age.[8] The estimates were

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[7]The term "head" as used here is a euphemism reflecting an arrangement of the data made for convenience. The data are arranged so that key data on persons within each household are organized in a consistent pattern across observations. In particular, the key indexing person ("head") is taken to be the male in a married couple or a mixed-sex couple-by-affection, the older individual in a same-sex relationship, or a single individual when the primary economic unit is not centered around a couple.

[8]No doubt, it would be quite interesting to track changes above the 90^{th} percentile as well. Unfortunately, spread across the distribution of the conditioning variable, the data are too thin for such estimates to be reliable.

made using a kernel estimator, and the resulting plot was smoothed across each contour. As before, the vertical axis has been transformed using the inverse hyperbolic sine. Several interesting points are immediately apparent. First, the plots overall show a pattern consistent with life cycle behavior, with the quantiles rising with age until about age 65, and then declining somewhat–though note that the data are also consistent with an interpretation in terms of cohort differences. Second, the degree of negative net worth for the ages below 30 shows clearly the importance of borrowing by that group–for education and starting out in life. Third, in terms of levels, it is clear that the distribution spreads as age rises up to about age 65.

Because of the complicated nature of this figure, it would be too messy to superimpose multiple years of data, and displaying confidence intervals as well would further cloud the picture. In addition, the nonlinear transformation of the vertical axis makes it is difficult to assess from this figure the relative variation in wealth over age groups. To address these problems, two reconfigurations of the same data are used.[9] First, figure 4a looks at the patterns of the conditional median alone for 1992, 1995, and 1998. According to these estimates, the overall pattern is very similar in all these years, but it appears that relative to 1992, the center of the wealth distribution has shifted up for most groups above about age 35. At least a substantial part of the change for the older groups must be attributable to the fact that people over age 35 are more likely to have assets, such as homes and mutual funds, that would have shown substantial appreciation over this period. Second, to assess the variability of the distribution across age groups, figure 4b shows the distance of the 75th and 90th percentile contours from the median as a fraction of the median.[10] Aside from the endpoints of the estimation, the 75th percentile contour varies without apparent pattern across this time in a range around a few times higher than the median. The 90th percentile contour is much more variable, ranging (again ignoring the endpoints) from about 5 to 12 times higher than the median, but it also shows no strong trend over this time. One might expect to see greater dispersion at either end of the age distribution:

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[9]Neither of these plots solves the problem of displaying confidence intervals. Consistency of trend over the period will be taken here as an indicator of statistical significance.

[10]The comparable estimates for the 10th and 25th percentiles are not shown because they are very flat over the whole range except for the negative dip of the 10th percentiles below age 30, and there is only negligible percentage variation.

younger people who have inherited money will be at least temporarily above most members of their cohort, and among the older population, there is evidence of socioeconomic differentials in mortality (see Jianakopolis *et al.* (1989) and Kitagawa and Hauser (1973)) that might tend to magnify differences. In fact, the signs of change in these relationships over the 1992-1998 period are weak. There is at least an indication that wealth may have become more skewed in the 30 to 35 and the 55 to 65 age ranges. The data suggest that dispersion may have declined among the youngest and oldest groups; however, because the data are relatively thin at both extremes, these differences may simply be noise.[11]

Popular reporting suggests that one might find that the relationship between income and wealth changed over the 1992-1998 period. Two factors seems most compelling. First, some people who earned relatively low regular incomes made large wealth gains through share ownership or stock options. Second, there may also have been people who had newly attained substantial incomes, but who had not yet accumulated their equilibrium level of assets. For individuals with large amounts of wealth that can be tapped for consumption, there is also an incentive to minimize income by channeling investments into tax-preferred instruments, or, particularly in a time of rising asset prices, into assets whose returns tend more to be in the form of unrealized capital gains.

Using income as a conditioning variable, figure 5 shows the distribution of wealth in 1998 using the same estimation methodology as that underlying figure 3.[12] At the median, income and wealth appear to have an approximately log-linear relationship away from the bottom of the income scale. The second part of the figure indicates that there is a relatively large

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[11]One factor that explains the relative thinness of the younger age groups is that the fact that often people who are attending school do not maintain independent residences that would be included in the SCF sample. Moreover, many of the interviews were conducted during the summer when students would be more likely to be living with their parents, and the age of that household would be indexed in the plots by the age of the household "head."

[12]Beginning in 1995, the SCF has asked respondents whether their current income is unusually high or low, and if it is unusual in either direction, it asked what the level of "normal" income would be. Previously, only current income was available. Figures 5 and 6 use normal income for 1995 and 1998 and current income for 1992. In 1998, 25.5 percent or families reported having unusually high or low income. In analysis, normal income appears to perform, as it is intended, as a less noisy indicator of permanent income than current income.

dispersion in wealth at the lower end of the income spectrum and that the spread is relatively steady in (approximately) log terms above that.

The time path of the median from 1992 to 1998 indicates changes both among low income households and among those with incomes above about $250,000. Families with incomes between about $10,000 and $20,000 saw a steady deterioration of wealth over this period. However, at the same time, the proportion of households with such low income also declined somewhat (see Kennickell *et al.* (2000)). For the higher-income households, there is a shift up in median wealth relative to 1992, but the change from 1995 is not as clear. For families in other income groups, the changes in the median are more mixed over the period.

In all three years, the relative patterns of dispersion are similar (figure 6b). However, the only notable shift in dispersion is at the lower end of the income distribution, where the decline in median wealth was noted above. In this income region, there was an increase in the spread of the wealth distribution over the three surveys

Education is generally believed to be a key factor in the determination of labor income, and saved income is an important source of wealth. To the extent that education also enhances a person's ability to manage money, one might expect an even stronger relationship between education and wealth. Figure 7 shows the conditional distribution of wealth given the number of years of formal education of the household "head" for 1998.[13] The median shows a decline from 9 to 11 years, a fact that is attributable, in part, to cohort effects. For cases with 9 or fewer years of education, the average age of the "head" in 1998 was 58, compared with 46 for the group with 10 years, 45 for the group with 11 years, and 49 for the group with 12 years; life cycle differences alone could account for the higher wealth of the group with the lowest level of education. Median wealth approximately doubles with completion of 12 years of education, 16

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[13]The SCF measures years of formal education as discrete values ranging from zero to 17 or more years. Thus, in contrast to the case of figures 3-6, it is less appropriate to smooth the contour estimates across the conditioning values. Owing to the relatively small number of observations where the household "head" had a value of 9 or fewer years of formal education, all such cases are combined in figures 7 and 8. Sometimes people may have passed an examination for some type of high school equivalency certificate. Among the group with fewer than 12 years of formal education, the frequency with which heads of household report having acquired such certification peaks in the 11 year group at 28 percent in 1998; among the group with 10 years of education the figure was 18 percent, and for the lowest group it was 14 percent.

years of education, and 17 or more years of education. Similarly to the conditional distribution by age, the distributional contours other than that for the 10th percentile track the movements of the median; the 10th percentile is at or near zero until the top of the education range, where it turns up for those with 17 or more years of education.

As shown in Figure 8a, the general pattern of the median holds over the 1992-1998 period. What appears most notable over this period is the upward shift in the median level of wealth associated with levels of education above 12 years, consistent with stories about increasing returns to education over the period. The direction of change is consistent for the groups with 16 or more years of education over the period; for the other groups above 12 years, there was a reversal in 1995 that was more than offset in 1998. Perhaps surprisingly, the data in figure 8b indicate that there was no consistent relative shift in the upper tail of the conditional distribution. In each year, the data show the maximum proportional skewness of the distribution is for the group with 11 years of education, the group with the lowest conditional median in 1992 and 1995 and just above that for the 10 years group in 1998. The level of dispersion in this group appears to be the results of a mixture of cohort and life cycle effects. Among this group, about 7 percent obtained an high school degree in fewer than 12 years, a group that is disproportionately over age 65; another 21 percent obtained a high school equivalency degree, a group that is disproportionately much younger; the remaining 72 percent is spread across all age groups, but is somewhat heavy relative to the simple population weight of the older age groups. The education expected of older cohorts to hold a job that would pay a “middle class” wage was relatively lower over their working years than is the case for younger cohorts. Moreover, because the older members of the group had more years to accumulate wealth, they will also tend to have more wealth than the younger people in the group. For those with 12 or more years of education, the 75th percentile is steady at about twice the median over the period; there is more fluctuation both within and across years for the 90th percentile for this group, but it is roughly centered around five times the median.

Conclusion

An important subsidiary goal of this paper is to introduce broader means of decomposing distributions than is possible with a small set of summary statistics. The paper does not aim to displace summary statistics, which may be quite useful for characterizing particular aspects of distributions. Quantile difference (QD) plots, which show the differences in the levels of two distributions at each quantile of the distributions, provide insight into how the shapes of distributions differ over time or over different populations–or both as in the QD plots of difference in wealth between regions stacked together for different years. Dividing the differences in the QD plot by the base period level yields a plot of distribution of the relative changes. Conditional distribution plots provide a broad view of how distributions vary across another dimension, but they are messy for looking at changes over time; in this paper, the temporal dimension is addressed by plotting the median separately along with ratios of the 75^{th} and 90^{th} percentiles of the distributions as a ratio of the median. Clearly many other graphical devices of these sorts are possible.

What can we tell from these plots? From 1992 to 1998, the bottom of the wealth distribution added debt, another group remained at about zero wealth, and the rest of the distribution added wealth–particularly the top of the wealth distribution. View in terms of proportional growth, about the middle three-quarters of the distribution experienced similar substantial growth, but the top few percent of the distribution saw much higher growth. Over the four regions of the U.S., the graphical analysis reveals complex differences in the shapes of the wealth distributions. The northeast was ahead of the southern and north central regions overall; but the middle of the distribution for the northeast was ahead of the western region only in the middle–and showing signs of being increasingly so–while the western region is wealthier at the top. The north central region also shows a wealthier middle than the western region, and the southern region seems to be showing a trend in that direction.

The conditional distributions of wealth given age, income, and education show greatest variability in the wealth of people around retirement age, those with relatively low incomes, and those with low levels of education. However, given the nature of the changes between 1992 and 1998, it is quite surprising how little systematic trend there appears to be in the changes in these distributions. Ordinarily one would turn to modeling to deal with problems beyond one or two

dimensions. One means of preserving the insight of the graphical approach might be to use regressions to "purge" wealth of effects of variables other than a single dimension, such as age, income, and education, and to display the resulting quantity graphically.

There are two other obvious next steps in this research. First, data from the 2001 SCF should be available for analysis soon, and it would be particularly interesting to see the state of the wealth distribution at the time of the first break in the growth since the early 1990s. Second, it would be useful to look with broad graphical means at the role of different classes of investments in the observed wealth distributions. Typically, such analysis rests on simple portfolio shares or ownership rates for groups, but the distribution of ownership may also be quite variable.

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Figure 1a: Quantile difference plot: Net worth in 1998 minus net worth in 1992 (1998 $), by quantiles of the distribution of net worth; 1998 dollars.

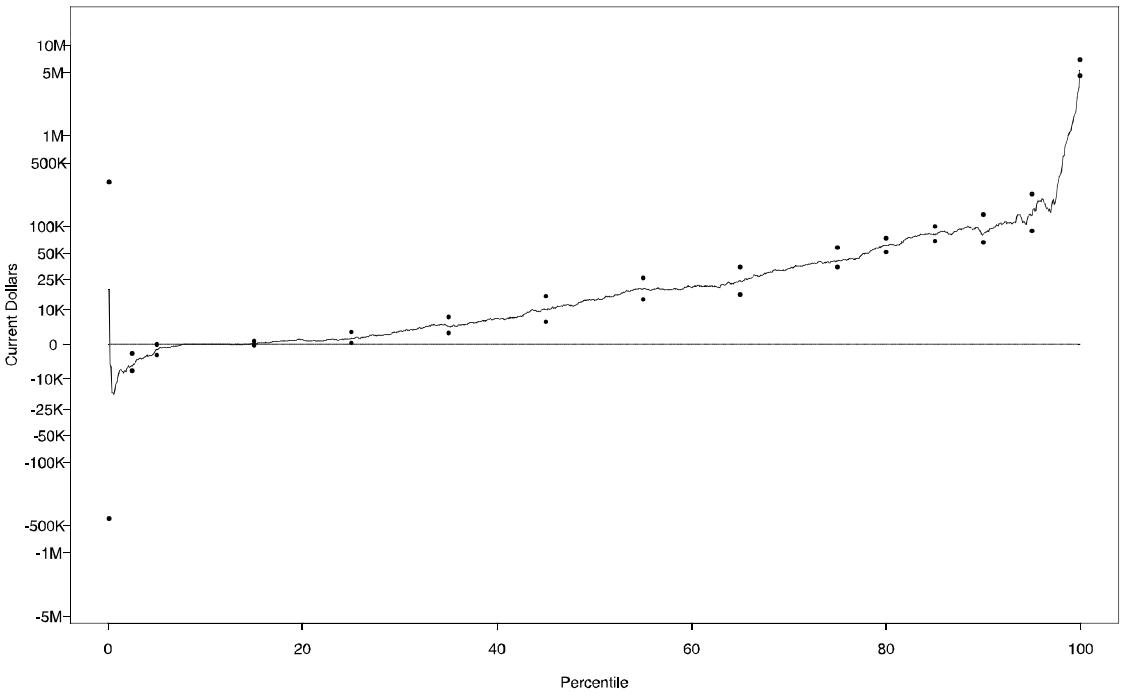


Figure 1b: Relative quantile difference plot: Net worth in 1998 minus net worth in 1992 (1998 $) as a percent of net worth in 1992; by quantiles of the distribution of net worth.

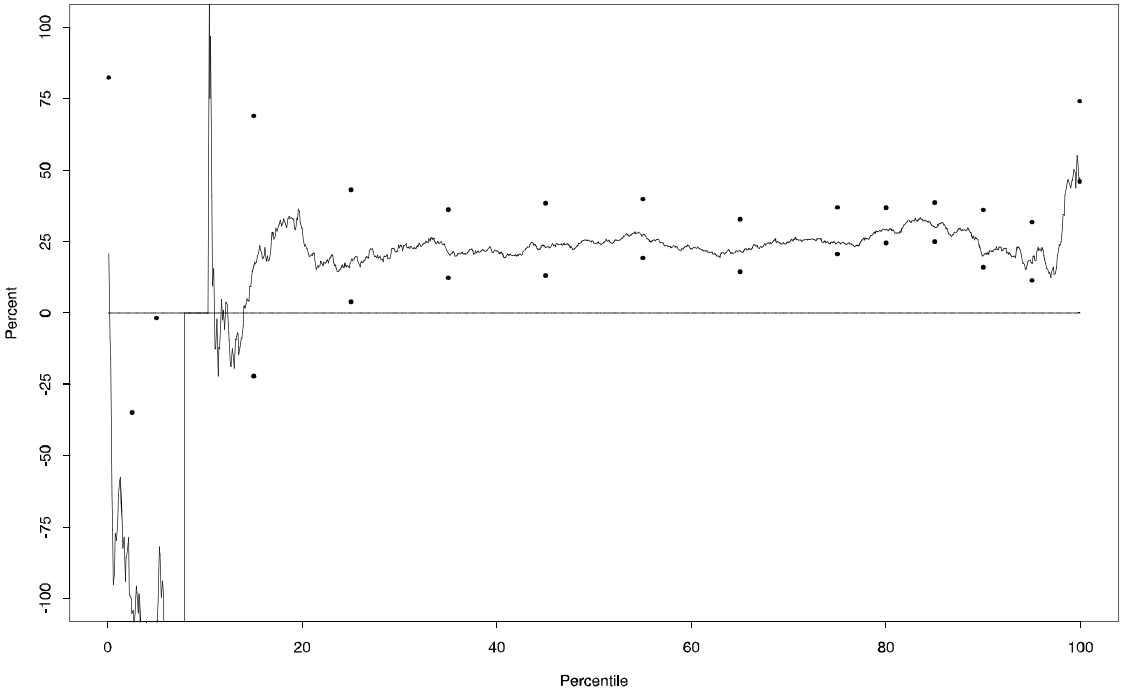


Figure 2: Quantile difference plots of net worth (1998 $) in one region minus net worth in another region, by quantiles of the distribution of net worth; for the four regions of the U.S.; 1992, 1995, and 1998.

Figure 2a: Northeastern region minus north central region.

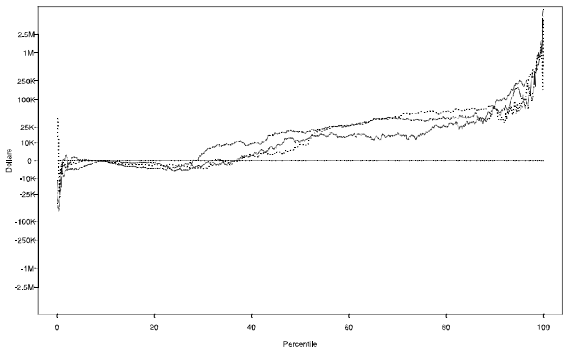


Figure 2b: Northeastern region minus southern region.

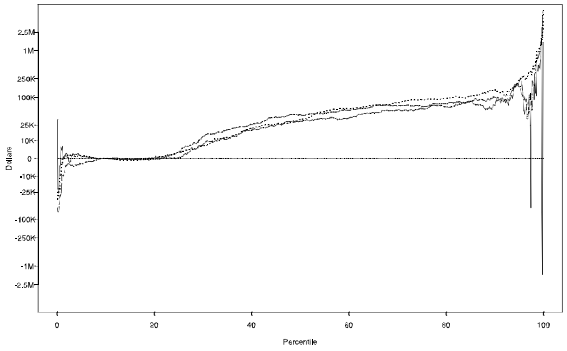


Figure 2c: Northeastern region minus western region.

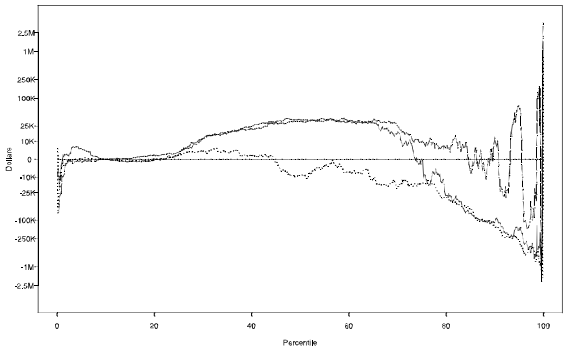


Figure 2d: North central region minus southern region.

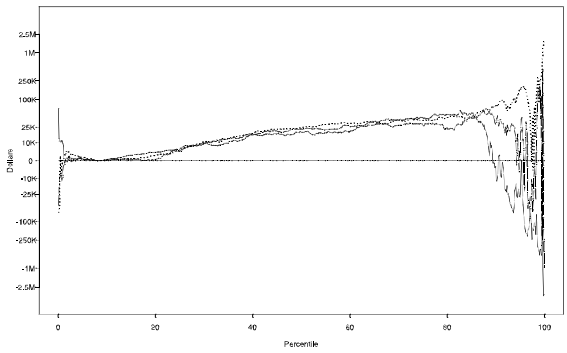


Figure 2e: North central region minus western region.

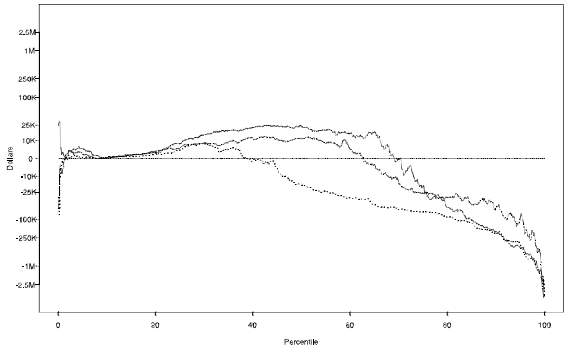
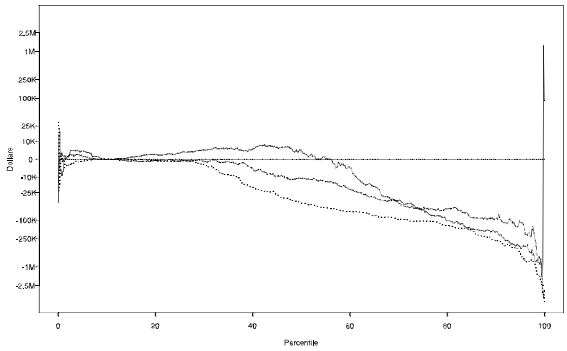
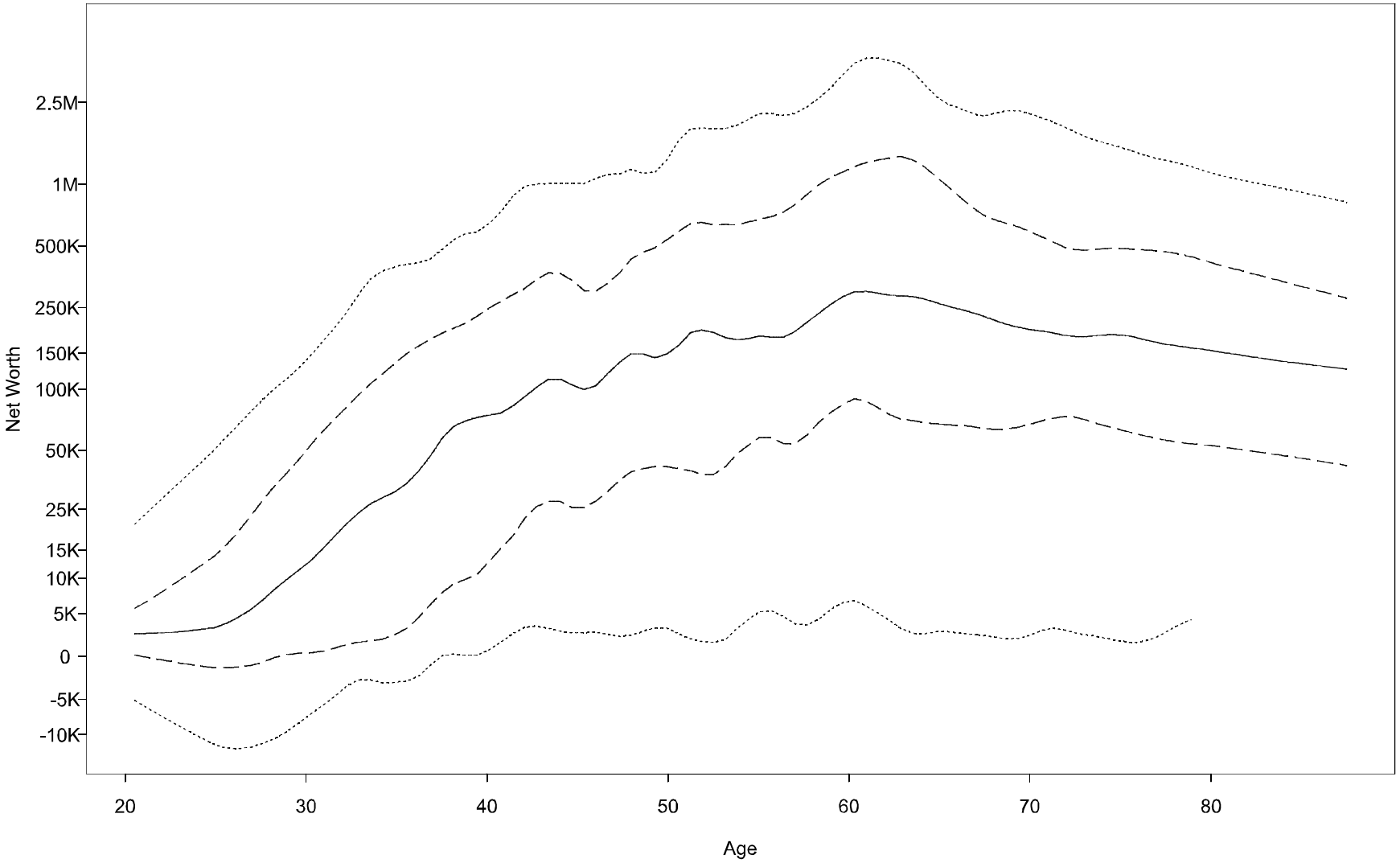


Figure 3f: Southern region minus western region.



..... **1992** – – **1995** — **1998**


2.5M
1M
500K
250K
150K
100K
50K
25K
15K
10K
5K
0
-5K
-10K
Net Worth
20
30
40
50
60
70
80
Age